Fast-track rehabilitation after anatomical lung resection: prospective single-center non-randomized trial

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Aim — to present the results of fast track rehabilitation after anatomical lung resection.

Material and methods. Single-center prospective non-randomized trial has included patients for the period December 2014 — December 2016. Conventional protocol was applied in 124 patients, 58 patients after atypical lung resections or pneumonectomy were excluded from the study. Thus, there were 66 patients aged 61 (51; 67) years. Men/women ratio was 37:29. Lobectomy (n=55) and segmentectomy (n=11) were performed for lung cancer, metastatic injury and various inflammatory diseases in 53 (80.3%), 8 (12.1%) and 5 (7.6 %) cases, respectively. ASA risk score was II (16), III (46), IV (4). Video-assisted/open procedures ratio was 42 (63.6%) / 24 (36.4%).

Results. 30-day postoperative morbidity was 7.6% (5 out of 66 patients, 95% CI 3.3—16.5). Pleural drainage tube was removed within the 1st postoperative day in 49 (74.2%) out of 66 patients. Prolonged insufficient aerostasis was observed in 3 patients followed by effective conservative treatment. Overall mortality was 3% (n=3, 95% CI 0.8—10.4) due to pulmonary embolism and sudden cardiac death. Median of postoperative hospital-stay was 7 (6; 9) days without significant differences between groups of lobectomy and segmentectomy (p>0.05).

Conclusion. Fast track rehabilitation protocol in thoracic surgery is safe and effective. Further studies are needed to justify early rehabilitation in high risk patients.

Keywords: fast-track rehabilitation, anatomical lung resection.

Relevance. Fast track rehabilitation in surgery is a set of perioperative measures based on interaction of multidisciplinary team, evidence-based medicine and aimed at reducing morbidity, early recovery and decrease of length of hospital-stay. The concept of fast track rehabilitation in surgery was first formulated over 20 years ago. H. Kelet, L. Bardram and T. Mogensen. One are one of the pioneers of fast track philosophy. They first published the results of multimodal perioperative management of patients in colorectal surgery [1]. «Enhanced recovery after surgery» (ERAS) Study Group was formed in 2001—2004 and reorganized to the European Society (ERAS society) in 2010. European Society for Enhanced recovery after surgery have officially approved and published 12 protocols for various surgical fields by early 2017 [2]. Introduction of enhanced recovery program in patients with high risk of surgical complications is still relevant, for example in thoracic surgery [2]. Outcomes of modified protocol of fast track rehabilitation after anatomic lung resection are presented in this report.

Material and methods. Lung resection has been performed in 124 patients for the period from December 2014 till December 2016 in the Thoracic Surgery Department of Vishnevsky Institute for Surgery. Unified protocol of perioperative management was applied in all patients.

Description of fast track rehabilitation protocol in thoracic surgery. Each patient underwent multidisciplinary examination by surgeon, anesthesiologist and specialist for intensive care prior to hospitalization. Oncological consultation was necessary for suspected malignancies. Smoking patients were counseled regarding possible cessation. Preoperatively, patients received manual specially developed by our team which specified features of forthcoming surgery, main rehabilitation stages, daily schedule of examinations and physiotherapeutic procedures, criteria for discharge from the hospital and possible postoperative complications.

Preoperative protocol imposes complete refusal of mechanical bowel preparation and fasting prior to surgery, carbohydrate load on the day of surgery (sweet clear drink 200 ml). Low-molecular-weight heparin was preventively administered 12 hours before surgery in patients with high risk of thromboembolic complications according to «Russian Guidelines» [3]. Prevention of infectious complications has been carried out within 24 - 48 hours with initial injection of the drug 1 hour prior to skin incision according to «Russian Guidelines» (2012) [4]. The protocol also included preoperative incentive spirometry, no routine sedatives administration prior to surgery. Intraoperative period consisted of rational infusion therapy [5], deliberated vasopressors administration, protective ventilation [6], multimodal analgesia with mandatory use of certain conductive blockade (paravertebral or epidural block), normothermia. In all cases surgeon deployed catheter for paravertebral block under precise control at the final stage of surgery.

Minimization of surgical trauma. Technologies associated with reduced surgical trauma are currently one of the priorities of thoracic surgery. Nevertheless, we do not consider «open» procedure or «conversion» are deviation

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from fast track rehabilitation protocol. In postoperative period: immediate or early extubation, early (the 1st day) onset of nutrition and activation (verticalization) of patient; removal of pleural drainage tubes after complete aerostasis and output volume less than 250 ml in 1—2 days after surgery; continuation of multimodal analgesia (removal of paravertebral or epidural catheter 48—72 hours after surgery); analgesia effectiveness control using visual-analogue scale (VAS). Application of checklists and internal audit of the protocol at least twice a year.

Anatomic lung resections (lobectomy, segmentectomy) were performed in 66 (53.2%) patients, atypical (sublobar) resections — in 58 (46.8%). Patients who underwent atypical resections were excluded from statistical analysis. Thus, 66 patients were enrolled (median age 61 (51; 67) years). Male/female ratio was 37/29. Patients were operated for non-small cell lung cancer (NSCLC), secondary malignancies and non-tumorous lung diseases in 53 (80.3%), 8 (12.1%) and 5 (7.6%) cases, respectively (Fig. 1). Stage I—II was predominant in NSCLC patients (according to TNM 7 classification). Distribution of patients by stages is shown in Fig. 2.

Anesthetic risk scoring was made using ASA (American Society of Anestesiologists) scale. Grade II was in 16 (24.2%), III — 46 (69.7%), IV — 4 (6.1%) patients. Postoperative complications were considered using Clavien—Dindo scale [7].

**Results**

40 (61%) patients were hospitalized 1 day prior to surgery. Preoperative hospital-stay was 0—7 days (median 2 (1; 5) and mode 1 day, respectively). Lobectomy was performed in 55 patients, segmentectomy — in 11. Video-assisted/open procedures ratio was 42 (63.6%) / 24 (36.4%) (Fig. 3). Video-assisted interventions were performed through single port with deployment of additional trocar for the camera. Pleural drainage tube was removed within 1 day after surgery in 49 (74.2%) patients. 30-day postoperative complications were observed in 5 (7.6%) patients (95% CI 1.3—16.5). Incomplete aerostasis responsive to medication (> 5 days) was noted in 3 patients. Overall mortality was 3% (n=2) (95% CI 0.8—10.4) and associated with pulmonary embolism and sudden cardiac death. There were no complications associated with epidural (arterial hypotension, acute urinary retention, postoperative nausea and vomiting) and paravertebral analgesia. Efficacy of different methods of conductive analgesia was not compared in this trial.

Median of postoperative hospital-stay was 7 (6; 9) days without significant differences between groups of lobectomy and segmentectomy (p>0.05).
Discussion

Reduced risk of complications is the main purpose of fast track rehabilitation protocol. Only multidisciplinary team each specialist of which fully participates in preoperative preparation and postoperative rehabilitation of the patient can implement the program. Application of fast track rehabilitation program in thoracic surgery is still unclear despite great number of researches in abdominal, colorectal surgery, urology and other fields [2, 8]. Systematic review of Fiore J.F. et al. (2016) included only 6 trials devoted fast track rehabilitation in thoracic surgery while only 1 of them was randomized [8]. A. Brunelli et al. analyzed the outcomes of fast track rehabilitation program after video-assisted anatomic lung resection. The authors did not observe significant differences between conventional and modified approach regarding incidence of cardiopulmonary complications, 30- and 90-day mortality, length of hospital-stay and incidence of redo hospitalizations [9]. On the other hand, there are trials confirming the advantages of individual elements of enhanced rehabilitation protocol in reducing postoperative morbidity and entire program for improvement of pain syndrome, decrease of hospital-stay after lobectomy and pneumonectomy [10, 11].

There were no randomization and control group in our research. This is primarily due to the philosophy of enhanced rehabilitation protocol where each element is based on individual clinical recommendations. Our algorithm is based on recommendations of the European Society of Thoracic Surgeons (ESTS) for enhanced rehabilitation after lung surgery and was supplemented and adapted to certain surgical hospital [12]. Team of specialists discussed each part of the protocol. We did not exclude patients from fast track rehabilitation program if this protocol was not fully implemented and/or postoperative complications occurred. Nevertheless, some elements of the protocol require discussion in thoracic surgery.

Smoking cessation and physiotherapy. K.M. Mussalam et al., M. Gronkjaer et al. reported reduced risk of wound, pulmonary and neurological complications, generalization of infection and redo admission to ICU in case of preoperative smoking cessation [13, 14]. We advise to stop smoking 3—4 weeks prior to surgery. However, this recommendation is only advisory since time interval between initial consultation and surgery is often less than 2 weeks. Moreover, some patients consciously continue smoking.

The role of incentive spirometry is still unclear regarding reducing of postoperative incidence of respiratory complications and pain syndrome severity. At the same time, this is one of the measures increasing patient’s adherence to rehabilitation protocol [15, 16].

Surgical approach. Minimally invasive approach regardless type of surgery is reliably associated with reduced postoperative pain syndrome, earlier recovery and reduced risk of complications due to physical inactivity [17, 18]. At the same time, Q. Dong et al. analyzed the outcomes of fast track rehabilitation protocol in patients after pneumonectomy for central lung cancer in randomized trial. The authors noted significantly reduced cost and length of hospital-stay, earlier recovery of gastrointestinal motility in group of enhanced rehabilitation on background of similar postoperative morbidity [11]. This emphasizes that adaptation of enhanced rehabilitation protocol is critically important for advanced surgery. In these cases, minimally invasive approach is not usually advisable due to spread of primary disease or need for advanced resections with high risk of perioperative complications.

Anesthesia. Adequate anesthesia throughout surgical procedure is essential in reducing stress-response to surgical trauma. Rational and adequate intra- and postoperative analgesia is advisable to reduce the need for opioids and also to start early mobilization and nutrition [19]. Multimodal analgesia implies parallel effect on all aspects of pain pathogenesis and includes administration of nonsteroidal anti-inflammatory drugs (NSAIDs) combined with paracetamol and one of the types of neuroaxial or regional analgesia [19, 20]. The choice of epidural or paravertebral blockade in unclear in thoracic surgery. Thus, metaanalysis of R. Davies et al. [21] confirmed similar outcomes of paravertebral and epidural analgesia in 10 randomized trials consisted of 520 patients. Cochrane review of J. Yeung et al. [22] did not also demonstrate significant differences between paravertebral and epidural blockade while the risk of certain side effects including hypotension, nausea, vomiting, acute urinary retention was higher after epidural blockade. In our protocol of multimodal analgesia paravertebral or epidural blockade was selected randomly and effectiveness is not still compared.

Pleural drainage. Pleural drainage mode after lung resection potentially affects the possibility of early activation, severity of pain syndrome and length of hospital-stay. However, such issues as number of drainage tubes, duration of pleural drainage, active aspiration or passive drainage and even the diameter of drainage tubes are still discussable [23]. Systematic review of B. Deng et al. summarized 29 randomized controlled trials and 6 clinical studies aimed at optimizing pleural drainage after thoracoscopic anatomic lung resection. Thus, the authors concluded that one drainage tube has similar effectiveness regarding fluid and air evacuation and is associated with less pain syndrome and reduced hospital-stay compared with two drains [24]. Drainage tubes of small diameter (19 Fr) is also effective as those of standard dimensions (28—32 Fr) [25]. K. Ueda et al. [26] reported possible rejection of pleural drainage after lobectomy and tangential resection if complete aerostasis and lung inflation are confirmed. Active underpressure during pleural drainage can reduce the risk of prolonged failure of aerostasis [24]. However, the European (ESTS) and American (ATS) societies of thoracic surgeons recommend routine passive pleural drainage with the remark that passive drainage should be discontinued as soon as pneumothorax and/or subcutaneous emphysema have been occurred [25]. Nevertheless, it should be noted that the vast majority of trials did not include patients with morbid obe-
сити, инфекции, диабет, другие факторы, влияющие на выбор метода лечения. Мы полагаем, что методика лечения плевральной недостаточности должна быть индивидуализирована, учитывая организм пациента и условия лечения. Мы не считаем, что быстрый метод лечения следует применять для всех пациентов, а частота его использования должна быть определяема индивидуально. Наш метод лечения является безопасным и эффективным.

Limitations of the study. Statistical analysis included only those patients who underwent anatomic lung resection. The main objective of this study was not presentation of an “ideal patient” who may be quickly operated and discharged. We have tried to analyze advantages, disadvantages and effectiveness of fast track rehabilitation program in thoracic surgery when this protocol is applied for all patients within certain surgical department.

Thus, enhanced rehabilitation protocols in thoracic surgery was confirmed as safe and effective. Further studies are required to justify early rehabilitation in patients with high risk of perioperative complications.


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